Dr. Robert Leheny
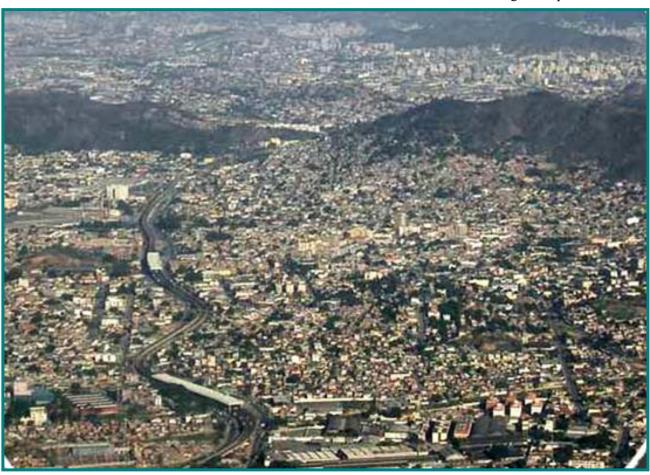### Deputy Director, DARPA

DARPA's Urban Operations Programs

DARPA is all about answering the most pressing technological needs of America's warfighters. And no technological challenges are more immediate, or more important for the future, than those posed by urban warfare. DARPA's largest and most intensive new program is its Urban Operations program.

Iraq is not the first modern urban environment to challenge a military power. Think of Russia's experience in Chechnya. After pursuing a strategy of widespread destruction in Groznyy, Russia now confronts a hostile civilian population and a continuing insurgency.

Think of our own experiences of the last decade: Mogadishu, Sarajevo, and now Fallujah and Baghdad.

What we are seeing today is the future of warfare. It is a future where half the world's population will be living in cities, and where our adversaries, unable to challenge us on open battlefields, will force the fight into crowded urban areas that maximize their advantage.

DARPA began addressing the challenges of urban warfare long before the current conflict in Iraq and, over the past decade, has built a portfolio of impressive programs. Largely as a result of what our Armed Services are facing in Iraq, and in

recognition that their experiences represent the future, we announced at DARPATech 2004 that we were elevating urban warfare to the level of a strategic thrust.

What does it mean for Urban Area Operations to be named a DARPA strategic thrust? It means that DARPA is putting the scientific and technical world on notice that urban operations is an area in which we're prepared to invest substantial resources. It is a sign of our commitment to meet the DARPA-hard challenge of creating new capabilities for our troops operating in urban areas. Capabilities that will make our Cold War force as effective in cities as it is on traditional battlefields.

We started by asking ourselves: What different challenges do cities pose to our warfighters?

Cities are filled with man-made, man-scale, three-dimensional structures—buildings with complex interiors, exterior alleys, interlocking subterranean tunnels. Structures that provide almost limitless places for insurgents to hide, store weapons, and maneuver. They are where insurgents can live and mingle with noncombatants, significant numbers of whom are sympathetic to, intimidated by, or apathetic about the insurgency. Cities are hubs of transportation, information and commerce—focal points of an entire country's infrastructure for communications, power, water, and other utilities essential to civil life. They are repositories of a nation's financial, political, and cultural institutions. They are home to people we hope will become our hosts and neighbors when hostilities end.

In short, cities are places full of elements so important they must be protected, and so are obstacles to our ability to maneuver and apply force.

In cities we must act not only with military strength, but also with an understanding of the situation that goes far beyond the military objectives of capturing territory or reducing obstacles to rubble.

We've come to recognize that fighting in the urban environment is fighting a Three-Block War:

- Humanitarian operations

- Stability and support operations

- A shooting war

We recognize that in cities, where there are many more noncombatants than combatants, our troops are not just warfighters but also goodwill ambassadors of the United States.

Today's warfighter draws strength from a spectacular array of technology, much of which DARPA helped to create. This technology enables us to dominate in battles between nation states so much that no nation can stand up to our forces and, thank God, few even contemplate it.

This dominance is largely the result of 60 years of developing and fine tuning our capabilities on the traditional battlefield.

But the battlefield has changed. In the urban battlefield, our stand-off reconnaissance systems are severely constrained in providing detailed actionable information. In the urban battlefield, our weapon systems must be ever more precise. Our vehicles and tactics that work so effectively in the open must be redesigned for close quarters.

By drawing us into these urban areas, our adversaries hope to neutralize the advantages of our technology. And by neutralizing our technology, they anticipate we will be forced to commit more troops to the fight. And more troops mean more US casualties. By drawing the conflict into the cities and holding civilian populations hostage, our adversaries' goal is not to win a military victory, but to force our leadership into making costly mistakes—mistakes that cause collateral damage, inflict casualties on friendly forces, and harm civilians and neutrals. Mistakes that an out-numbered, out-matched adversary can exploit, winning a victory on the world stage of public opinion that he cannot win on the battlefield.

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These are the challenges of urban warfare in the 21st century.

So how can technology help meet these challenges? The answer lies in what is unique about urban operations.

The scale of an urban battle is a human scale, measured in meters rather than kilometers. It is a scale that demands superb spatial precision, where weapons must deliver precise destructive force. It is a scale where space and time also shrink. Information becomes obsolete the moment an adversary or a blue force moves from one city block to the next, one building to the next. Time for decision-making and acting on those decisions is measured in seconds.

There is the added challenge of understanding the full complexity of the urban battlefield—a challenge that goes beyond situational awareness, beyond the enemy's force strength and disposition, and involves taking into account noncombatants, their culturally significant monuments, and their enduring values.

What are the options for dealing with an enemy force taking refuge in a city? Historically there have been three. The first is to lay siege to the enemy and the city at large. By cutting off enemy forces from outside contacts and supplies with an impenetrable ring, besiegers literally starve the besieged into suing for peace. The drawbacks are obvious. What the enemy suffers, the city population suffers. Given global media coverage and the willingness of our enemies to exploit this suffering, sieges have limited effectiveness.

A second option is total destruction, turning the city into rubble. It is an option that is even less attractive than siege, assuming our long-term objective is winning the hearts and minds of the people. The Russian experience in Grozny makes this point.

That leaves only one option: advancing into the city and confronting the enemy directly. The reality on the ground is that all three options often are used simultaneously. But it is direct combat that can be most to our advantage, provided we can give our

warfighters capabilities that are specifically tailored to the urban environment.

Capabilities that, for example, allow us to establish surveillance that provides robust, dynamic situational awareness on all the scales of the city. Compared to our current airborne capabilities, the new sensor and surveillance systems required must provide far more detailed and fundamentally different information and coverage.

We need significantly improved persistent, staring reconnaissance and targeting systems that can be proliferated throughout the battle space, systems that allow us to see into the canyons of the urban landscape, that provide 3D images of unprecedented clarity. In addition, we need a network of nonintrusive microsensors, creating the ability to map an entire city, and the activities within it, in all three dimensions and over time. The goal is to extend our awareness to the level of a city block so our forces have unprecedented awareness as the fighting begins, a level of awareness that enables them to shape and control the conflict as it unfolds. Because of the shrunken time scale of urban operations, these dynamic capabilities must operate in near-real-time.

These ISR systems must be complemented by robust, secure communications that enable the sharing of information and insights at every level of command. Even in the noisy and chaotic fog of war and the mind-numbing complexity of the urban environment, these systems must allow our forces to know what is happening around them in real time.

Armed with superior surveillance and the ability to communicate, and with the aid of advanced weapons systems for delivering decisive, precision force, our troops will be fully prepared to maintain an aggressive tempo as the battle unfolds, operating inside the enemy's decision loop, successfully coordinating troop movements and weapons strikes in ways that knock him off balance and allow us to control the fight, minimizing his ability to respond.

These are the capabilities that urban warfare requires in the 21st century. DARPA has begun to deliver them.

Our Rapid Reaction program is delivering new technologies to our warfighters in Iraq. Over the past year, we've begun more than 35 study efforts on ideas received in response to our Agency-wide Urban Operations broad agency announcement. And we've launched a number of new programs across all DARPA offices and programs. We're targeted to spend more than $340 million on urban operations programs in the coming year and we anticipate these programs will grow to over $400 million in the out years.

What new capabilities are these efforts targeted to deliver? Consider how UAVs like the Predator are demonstrating their value in urban operations. We're building on this successes with programs in both the Information Exploitation Office (IXO) and the Tactical Technology Office (TTO). These programs are extending UAV capabilities and developing versions of small ground robots and limited-range UAV-based systems that will augment and extend human surveillance in high risk environments.

To deal with the proliferation of UAVs in the battle space, IXO is developing a command and control system that will allow cooperative interaction among UAVs operating in common air space and will automatically adapt and reprogram search and tracking missions as platforms enter and leave the area.

The Special Projects Office (SPO) is developing wall-penetrating radar sensors and other techniques for detecting and mapping underground structures, locating personnel, and identifying stored weapons.

Together, these systems will allow us to watch and track a particular person or object of interest no matter where he attempts to hide.

Today in Iraq, our Command Post of the Future system is helping commanders plan and communicate via networked work-stations. The

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Advanced Technology Office (ATO) is expanding the capabilities of this system with advanced information retrieval and other software technologies. The goal is to give commanders better access to time-sensitive, mission-critical knowledge and make the system more responsive to the commanders' needs.

IXO is developing effects-based data fusion tools that will allow commanders to gather information from all sources to rapidly plan and nominate critical urban targets. For planning in more realistic environments, IXO is developing technology to allow rapid, realistic 3D rendering of the battle zone.

These advanced and intuitive CAD tools will enable commanders to more effectively plan the battle, incorporate up-to-date estimates of the military and political environments that are operating in, and to capture from all sources the knowledge required for decisive action. They are tools that will assist in meeting long term strategic goals while maximizing short-term tactical effects.

In Iraq, coalition warfighters are broadly deployed and constantly on the move. They operate in environments filled with noncombatants and critical structures and infrastructure, from schools and hospitals to mosques and monuments. In such an environment, fine control over force application is critical, if for no other reason than to avoid friendly fire. To meet this need, DARPA is developing a number of new technologies.

ATO is developing cost-effective ways to convert munitions into radio and optically guided systems that have significantly improved geolocation capability. IXO is developing a fiber optic guided munition that allows non-line-of-sight operation and positive target identification. TTO is pioneering improvements in munition performance that will greatly enhance our ability to deliver the right level of force, to the right location, with minimum collateral damage.

We are also seeking to develop systems to deal with IEDs, RPGs, and similar threats. In this regard, we participated in the Joint IED Defeat Task Force search for a quick solution to counter IEDs and suicide bombers. One outcome of that participation is the realization that we cannot be satisfied with costly, partial solutions that address threats along roadsides and in suicide vehicles. The real challenge, the truly DARPA-hard task, is detecting and neutralizing IEDs and suicide bombers at their source.

The technology that can assist in this formidable task demands a cross-disciplinary effort. We must develop systems that can locate bomb factories and the bomb makers' supply lines. It is our best chance to destroy the infrastructure behind explosives attacks and put the insurgent leadership at risk.

IXO has taken on this challenge. And while the surveillance and information management systems we're developing will help, we're far short of what our men and women in uniform need. We ask for your ideas and assistance in bridging the gap.

The key enabler for almost all the technologies needed in urban warfare is a robust, adaptable communication network. A network capable of operating in urban environments, where communication can be difficult under the best conditions, made more challenging because the networks and their base-stations are continually in motion, with new nodes constantly entering and leaving the system.

ATO is working on just such a network. They are developing low-cost, low-power, ultra-wideband, wireless capabilities to deliver reliable, multipath, fade-resistant links with low probability of detection. Capable of automated routing, network reconfiguration, and spectrum management, these self-forming networks will almost eliminate human error in network setup and administration and make rapidly established and reliable communications a battlefield reality.

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In the area of microsensor communications, ATO is developing network protocols that significantly reduce the energy requirements of remote, persistent sensor systems.

After major combat has ended and we are in control, technology can enable us to conduct effective stability and security operations, even with significantly reduced troop deployment. This requires, among other things, that we improve our intelligence on general social, political, and economic conditions. We need to have these capabilities in place before fighting starts. Rather than learning as we go, we must incorporate culturally sensitive intelligence into our training tools and use it in war games.

To accomplish this goal, IXO is blazing new trails for DARPA. The office is engaging social anthropologists and other nontraditional resources to develop tools that analysts and planners can use to better understand and anticipate the conditions that create instabilities in nation states. We expect these tools will greatly enhance our military's ability to prevent destabilizing events or mitigate their effects.

The Information Processing Technology Office (IPTO) is extending the very successful Phraselator program to allow for two-way speech translation, greatly enhancing the ability of our troops to conduct stability and support operations. IPTO is also developing tools that will make every Soldier on patrol a sensor system, allowing him or her to collect and share observations and experiences quickly and effortlessly. By gathering and correlating this information, command centers will be able to develop the same detailed understanding of neighborhoods that a cop on the beat acquires over months of observation. To speed up the processing of intelligence gathered from sources in different languages, IPTO has initiated a program that is creating technology to rapidly translate large volumes of both speech and text.

The Defense Science Office (DSO) is extending its Rapid Reaction successes. It's improving the performance of armor while reducing its weight and enhancing casualty care both on and off the battlefield. It is exploiting PC-based videogame software to create user friendly simulation and multiplayer gaming tools. These tools will provide realistic training scenarios to better prepare our troops to communicate and interact with local populations by enhancing their cultural sensitivities.

Since DARPATech 2004, as the fighting in Iraq has continued and we have talked extensively with our warfighters, DARPA's resolve has grown. We are more determined than ever to implement our strategy and deliver to today's warfighters—and the warfighters of the future—the capabilities that will make them as effective in urban warfare as they have been in other environments.

But we cannot achieve this unless you, the community that DARPA invests in, come forward with your ideas, your insights, and your commitment. Powered by your ideas, and with a little help from DARPA, America's Armed Forces will continue to prevail throughout the world, especially in urban battlefields.